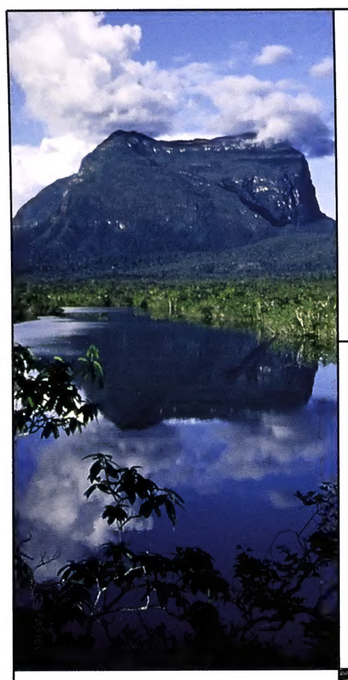
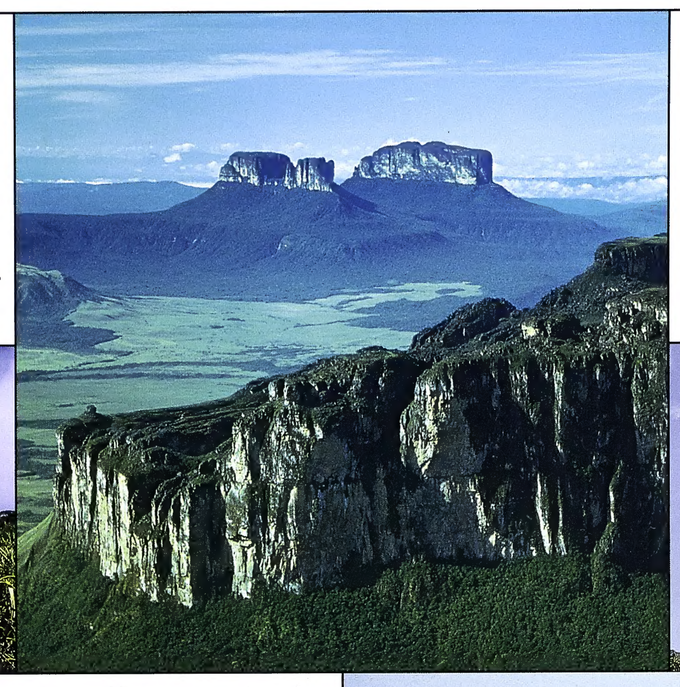
Research at the Missouri Botanical Garden

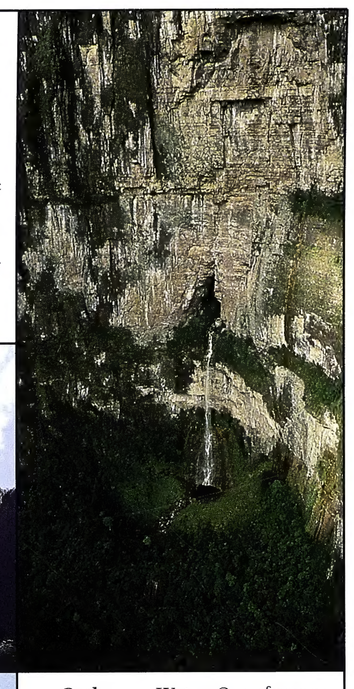
Flora of the Venezuelan Guayana



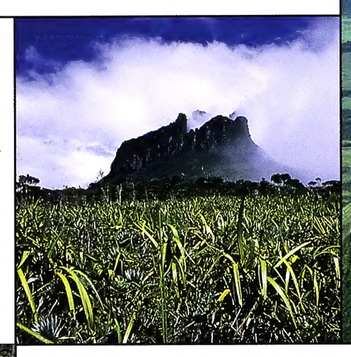
◂ **The "Lost World"— Flora of the Venezuelan Guayana** is the first full scientific account of the fabled "lost world" region made famous by Sir Arthur Conan Doyle. Paul Berry, Kay Yatskievych, and Bruce Holst are co-editors of the nine-volume publication, which has been based at MBG since 1984. It includes descriptions, taxonomic keys, and over 5000 illustrations of the nearly 10,000 species of vascular plants from the southern three states of Venezuela — Amazonas, Bolívar, and Delta Amacuro. The Guayana, or Guiana, Shield is a geologically ancient area studded with table mountains called tepuis. The tepuis are surrounded by large expanses of forest, as well as by savannas, shrublands, and rock outcrops. **It is a region of extraordinarily high endemism, with many plants that are found nowhere else on earth.** At left, Cerro Yapacana, a small tepui in Amazonas state, is mirrored in the lagoon of Caño Cotúa. At right, Angasima-tepui, with Chimantá-tepui in the foreground, towers over the western Gran Sabana plateau in Bolívar state. [OH, KW] ▸



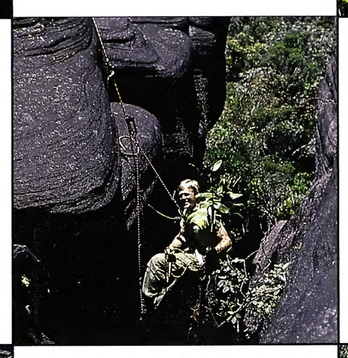
▾ **Habitat – Granite Peaks:** Cerro Aratitiyope, 1700 meters high, lies **in the middle of the remote homeland of the Yanomami Amerindians** in southern Amazonas state. Aratitiyope means "Mountain of the Macaws" in Yanomami dialect. Pairs of macaws frequently circle the peak. Most of the mountain above 1100 meters elevation is bare granite, with patches of low forest or hummocks in protected spots. Forest covers most of the lower shoulder of the mountain. [PEB]



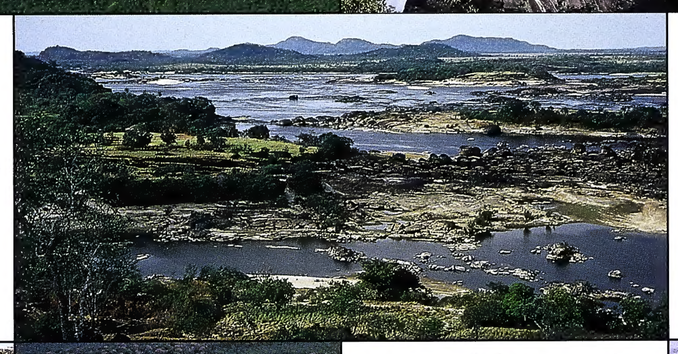
▸ **Species – High Endemism:** The peak of Kamarkawarai-tepui, one of a chain of relatively small tepuis known as "Los Testigos," lies along the northern edge of the Gran Sabana in Bolívar state. Here, it rises above an upland meadow dominated by large herbs of the genus *Stegolepis* in the monocotyledonous family Rapateaceae. **All 35 species of *Stegolepis* are endemic to high peaks or plateaus of the Guayana region.** [BH]



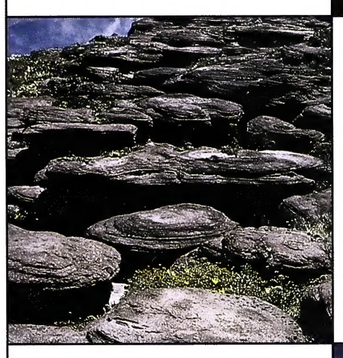
▸ **Exploration – New Discoveries:** Bruce Holst, co-editor of the Flora, on the summit of Aparamán-tepui with a specimen of the bamboo *Myriocladus distantiflorus*. All 13 species of Myriocladus occur exclusively on tepui summits. The high walls and dissected surfaces of **tepuis are very difficult to explore** and may require extensive, technical rock climbs. Aparamán-tepui, one of the last to be investigated by botanists, was first reached via helicopter in 1987. [BH]



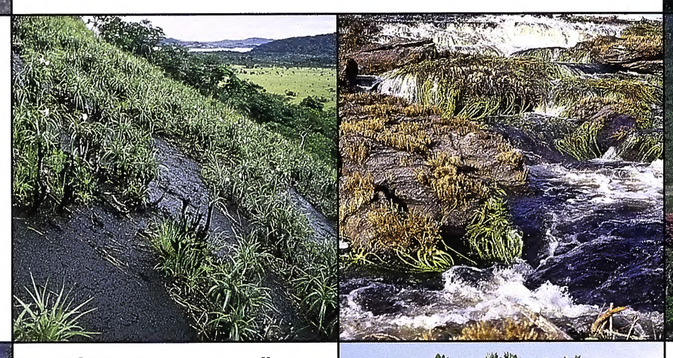
▸ **Habitat – Aquatic:** The Orinoco River is navigable up to Puerto Ayacucho, the capital of Venezuelan Amazonas state. Upriver of the town lies the Raudales de Atures (right), a long series of treacherous rapids portaged in 1800 by Alexander von Humboldt and Aimé Bonpland on their journey to the Río Negro. Today, a 60 km stretch of road skirts the Raudales de Atures and Maypures, and navigation upriver begins again at the mouth of the Río Samariapo. The falls of Salto Hacha (below) cascade into the lagoon at Canaima on the Río Carrao. They are covered with a tenacious flowering aquatic plant, *Rhyncholacis penicillata*, in the Podostemaceae family. These plants adhere to the rocks of the falls much as tidal zone marine algae fix themselves to a rocky seashore. The podostems are usually underwater, but **during the dry season the river level drops, and the plants produce flowers and fruits above the water level.** [GR, PB] ▾



▴ **Geology — Water:** One of many subterranean rivers found on Auyán-tepui, in Bolívar state. Tepuis consist of layer upon layer of compressed sand deposits (quartzite). Water penetrates fractures on the tepui summit to collect in underground rivers that surge out the sides of the mountain after heavy rains. **Angel Falls, the highest waterfall in the world**, pours over the eastern edge of Auyán-tepui for 979 meters (3,212 feet) to the forest floor below. [CB]



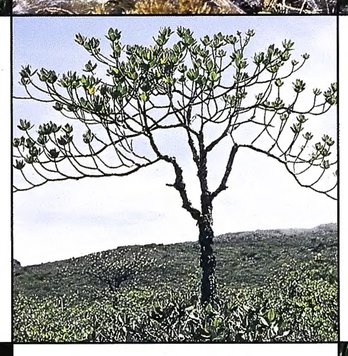
▸ **Species – Endemic:** Drought- and fire-resistant *Vellozia tubiflora* (Velloziaceae) on granitic domes known as lajas or inselbergs, part of the Precambrian basement rock of the Guayana Shield. The rocks' black color is due to a species of cyano-bacteria ("blue-green algae") that can withstand extremes in temperature and moisture and also fix atmospheric nitrogen. **A few dozen plants are known only from the outcrops that skirt the Orinoco River north of Puerto Ayacucho.** [AG]



◂ **Rivers — Black Water:** Aerial view of the Caño Pimichín (left), a black-water tributary in the Río Negro basin of southern Amazonas state. In the February dry season, pure white sand beaches appear on the banks. The purple-flowering trees are *Eperua purpurea* (Caesalpiniaceae). A dense clump of *Mauritiella aculeata* palms (right) are **characteristic of the high-tannin, low-sediment "black-water" rivers** such as the Río Temi and Río Atabapo. [OH, PB] ▸

▴ **Habitat – Rock:** A labyrinth of mushroom-shaped boulders along the edge of Ptari-tepui, Bolívar state. The crevices around these rocks support plants especially adapted to growing on rocks, including ferns in the Hymenophyllopsidaceae, a family endemic to the higher elevations of the Guayana Shield. Ptari-tepui has **an unusual flat summit that allows one to walk across the tepui with virtually no obstacles.** [BH]

◂ **Habitat – Rivers:** Seasonally flooded sand plains at the junction of three black-water rivers, Ríos Temi, Guasacavi, and Atacavi, in southern Amazonas state. **These poorly known habitats remain flooded up to nine months a year.** Several new species such as *Anaxagorea inundata* (Annonaceae) have recently been described. The wispy shrubs are mostly *Licania savannarum* (Chrysobalanaceae), and the herbs include an undescribed species of *Xyris* (Xyridaceae). [PB]



◂ **Adaptations – Trees:** A classic "sympodial" branching pattern on a small tree of *Bonnetia crassa* (Bonnetiaceae) on the summit of Cerro Guanay, a tepui in northern Amazonas state. The 30 or so species of *Bonnetia* are characteristic to tepuis, often dominating large patches of elfin or shrub forests. **Rosettes of tough leaves grouped at the tips of branches is a common adaptation of tepui plants.** [OH]

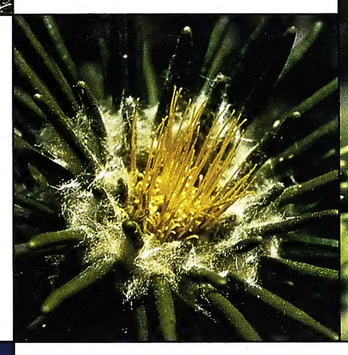
◂ **Endangered – Orchids:** *Cattleya violacea*, known as "Superba del Orinoco," is an epiphytic orchid once common along lowland rivers of the Venezuelan Guayana. Orchids are the largest plant family in the Venezuelan Guayana, with over 600 species and 150 genera. Early exploration of the Guayana Shield was driven, in part, by European orchid collectors. **Showy species continue to be gathered from the wild, despite effective means of cultivation.** [PB]

◂ **Selection – Controversial:** *Bonnetia maguireorum* (Bonnetiaceae), a gregarious, thick-stemmed species endemic to the Sierra de la Neblina. Like *Vellozia tubiflora* (row 4), it appears to have corky, fire-resistant stems, but it occurs around 2000 meters elevation in areas where fires are rare. It is controversial **whether infrequent naturally occurring fires on tepui summits play an important role in selecting species** able to survive and persist there. [CB]

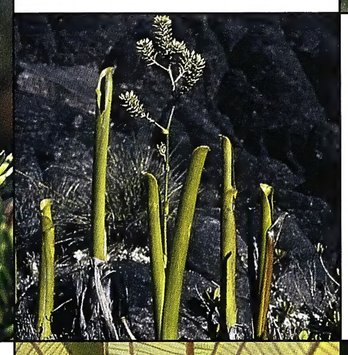
◂ **Endemic – Shrubs:** *Ledothamnus sessiliflorus* (Ericaceae) is a small, wiry shrub found on the summits of the eastern tepui arc in Bolívar state, including Roraima-tepui, where the borders of Venezuela, Guyana, and Brazil adjoin. It grows in rocky, exposed areas over 2400 m elevation. *Ledothamnus* is **one of four genera in the blueberry family that are endemic to the tepuis.** Others are *Mycerinus, Notopora,* and *Tepuia.* [CB]

◂ **Endemic – Pollination:** *Duidaea* is a genus of the Asteraceae (tribe Mutisieae), known only from two tepui summits in central Amazonas state. Three species occur on the summit of Cerro Duida, including the hummingbird-pollinated *Duidaea rubriceps* shown here. The fourth species occurs nearby on the higher summit of Cerro Marahuaka. The related genus *Gongylolepis* includes ***G. jauaensis*, purported to be bat-pollinated, which would be novel for this family.** [RL]

▸ **Endemic – Asteraceae:** Woolly flowering head of *Chimantaea mirabilis*, belonging to an endemic genus of Asteraceae, tribe Mutisieae. **All nine species of this genus grow on a single tepui massif**, Macizo del Chimantá, in a remarkable radiation of growth forms that resemble the rosette species of the Andean genus *Espeletia* in the same family. [OH]

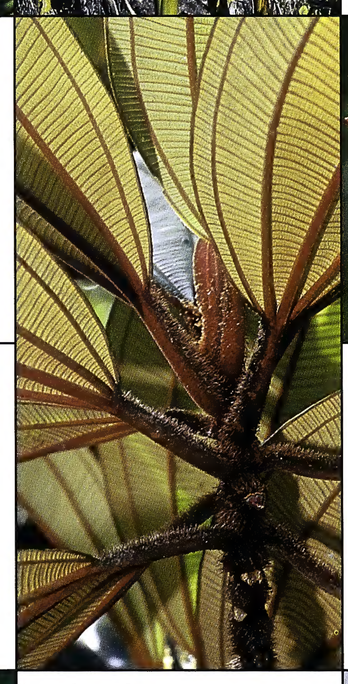


◂ **Habitat – Low Nutrient Soils:** Tubular leaf rosettes and a flowering stem of the carnivorous bromeliad, *Brocchinia reducta*. At least two of the 19 species of *Brocchinia* supplement their growth by digesting insects trapped in their leaf bases. **Carnivory is unusually common in the tepui flora**, a result of the acidic, extremely nutrient-poor substrates. [CB]



▴ **Endemic – Ferns: All 14 species of the fern genus *Pterozonium* (Pteridaceae) grow on sandy or rocky substrates of tepui summits.** Two of the species extend beyond the Guayana Shield and occur on similar sandy substrates in a few mountains of Costa Rica, southern Ecuador, and northern Peru. The species shown here, *Pterozonium maguirei*, is known only from the upper slopes of Sierra de la Neblina, along the Venezuela-Brazil border. [CB]

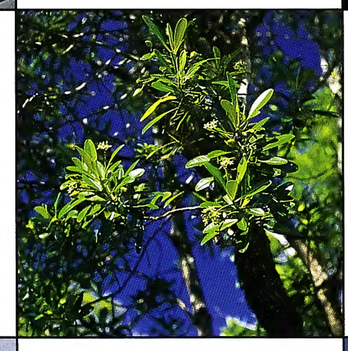
◂ **Tepuis – Carnivorous Species:** A remarkable example of carnivory in the tepui biome is *Heliamphora tatei* var. *tatei* (Sarraceniaceae, left), from bogs on the summit of Cerro Huachamacari in Amazonas state. The five species of this genus grow naturally on several tepui summits and in a few boggy sites of the Gran Sabana. **The species pictured here is the only member of the genus that has branched stems and can reach 3 meters in height.** The well-known North American relative, *Sarracenia*, grows in low-lying bogs throughout the East Coast and into the upper Midwest and Canada. The third genus, *Darlingtonia*, or cobra-lily, only occurs in northern California and southern Oregon. ***Miconia superba* (Melastomataceae, right) is one of the most distinctive species of a genus that has over 120 species in the flora area alone.** This species has very robust and hairy stems and is typical of the poorly studied tepui slope forests [CB, PB] ▸



▴ ▸ **Endemism – Bromeliads: Bromeliaceae has five endemic genera and a high percentage of the region's endemic species.** The genus *Navia* (*N. phelpsiae*, above) has nearly 100 species and defines the limits of sandstone distribution from eastern Colombia to Suriname. The genus *Lindmania* (*L. holstii*, right), with about 40 species, is common in the high elevation "pantepui" flora. Both genera include **many species known only from a single tepui.** [BH]

◂ **Carnivorous Species:** *Utricularia quelchii*, a member of the carnivorous bladderwort family, Lentibulariaceae. It grows as a terrestrial or as an epiphyte on small tree branches on several tepui summits. Forty-six of the 220 known species of *Utricularia* occur in the Venezuelan Guayana, making it **one of the largest concentrations of bladderworts in the world.** A second genus of bladderworts (*Genlisea* species) and sundews (*Drosera* species) are also well represented. [CB]

▴ **Pollination – Hummingbirds:** *Schoenocephalium teretifolium* (Rapateaceae) grows in moist white-sand savannas in southwestern Venezuela and adjacent Colombia. This genus, as well as *Guacamaya* and *Kunhardtia* in the same family, have **reddish, nectar-producing flowers that are pollinated by hummingbirds. They are characteristic of the white sand environment in lowland areas of the western Guayana Shield** and are gathered as souvenirs of the region. [GR]

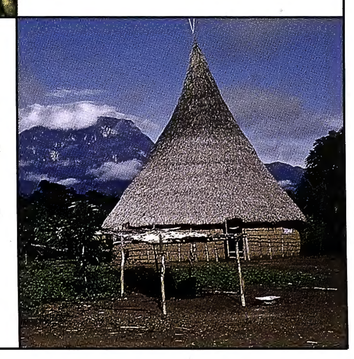


◂ **Distribution – Related Genera:** *Pentamerista neotropica* (left), a tree that grows on the edges of white-sand savannas in southern Venezuela and adjacent Colombia, is the sole member of the family Tetrameristaceae in South America. The sister genus *Tetramerista* has three species native to Malaysia. Similarly, *Pakaraimaea dipterocarpacea* from Venezuela and Guyana is **one of two genera in South America that are related to the diverse Old World Dipterocarpaceae.** [PB]

▸ **Evolution – Biogeography: *Saxofridericia grandis* (Rapateaceae) is a large herb known from a single tepui summit**, Cerro Parú, in Amazonas state. On a collecting trip there in 1988, Paul Berry discovered a striking new species, which he is naming *Saxofridericia globosa.* The nearly endemic family Rapateaceae is being **intensively studied to understand the evolution and biogeography of one of the most representative groups of the Guayana Shield.** [PB]

▸ **Industrialization – Mining:** Bulldozing forest to expose bauxite deposits in a state-run mining operation in the Serranía de los Pijiguaos. There are large deposits of aluminum and iron ore in the Venezuelan Guayana, and the country has harnessed the Caroní River to power huge smelting operations near Ciudad Guayana. **Widespread mining of gold and diamonds is more destructive to the environment, due to mercury contamination and extensive erosion of riverbanks.** [PB]

▸ **A Traditional Way of Life:** A classic palm-thatched home ("churuata") of a Piaroa Amerindian family in the Río Manapiare valley. It takes thousands of individual palm leaves to construct such a roof, which can last a decade. Inhabitants make temporary shelters using palm fronds over a frame of tree saplings tied with aerial roots of *Heteropsis* aroids as rope. The **Venezuelan Guayana is home to more than 30 different indigenous ethnic groups.** [PB]



▴ Dedication

In memory of Julian Alfred Steyermark (1909-1988), who initiated the Flora of the Venezuelan Guayana. *Steyermark's 28,000 individual plant collections from the flora area and his connections with colleagues worldwide made it possible to assemble the team of nearly 200 contributors for the project.* [SD*]

Research at the Missouri Botanical Garden

About 50 Ph.D.–level scientists, many of whom live abroad, assisted by about 80 technical staff and 25 graduate students, form the MBG Research Division. Their studies are concentrated on the plants of Mesoamerica, South America, Subsaharan Africa, Madagascar, China, Viet Nam, and North America. Individual MBG scientists are specialists in the plants of particular regions or in the classification of major plant families.

MBG serves as headquarters for the Center for Plant Conservation and for the major collaborative projects Flora of China and Flora Mesoamerica. To help disseminate botanical information, MBG floristic research and library resources are available on the Garden Web site at **http://www.mobot.org.**

MBG botanists collaborate with local institutions in each country where they conduct research, providing technical expertise, assisting with fundraising, establishing better communication with the worldwide scientific community, training botanists in the field and at MBG, and helping to build infrastructure.

Botanical research provides basic scientific knowledge needed to develop conservation policies to preserve global biodiversity.

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